1.0 Project Proposal Summary Sheet

Project Title Name: Lower Rapid Creek Watershed Assessment and TMDL Development

Lead Project Sponsor/SubGrantee:

SDSM&T	City of Rapid City	Proctor & Gamble
501 E. St. Joseph St.	300 6th Street	
Rapid City, SD 57701-3995	Rapid City, SD 57701	

Contact Person:

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Project Type: Watershed/TMDL Waterbody Types: Perennial Stream
NPS Category: PS and NPS (urban and agricultural) Extraction: N/A

Project Coordinates: Latitude: 44° 03' Longitude: 103° 18'

Major Goals: The primary goal of this project is to conduct a watershed assessment along lower Rapid Creek that will characterize point and nonpoint sources of pollution, providing information for identification and evaluation of watershed management alternatives and development of the Total Maximum Daily Load (TMDL) for lower Rapid Creek.

Project Description: The proposed study area (328 mi^2) is subject to urban stormwater runoff, irrigation withdrawals and return flows, wastewater treatment plant discharge, and runoff from agricultural areas. The 1998 South Dakota 303(d) Waterbody List identified the portion of this reach associated with the Rapid City wastewater treatment plant discharge as a 1998-2000 Biennium TMDL waterbody. Additionally, the reach below the treatment plant is listed under impairment-related TMDL waters. To develop a realistic TMDL for lower Rapid Creek the project must take on a watershed assessment approach recognizing the information needed for TMDL development. To be approved each TMDL must include seven components; 1) target identification, 2) identification of current deviation from target, 3) source identification, 4) allocation of pollutant loads, 5) implementation plan, 6) process for follow-up monitoring and assessment of effectiveness, and 7) process for TMDL revision (EPA, 1998). This project proposes to complete the first four components and provide recommendations for the implementation plan.

FY 1999 319 funds requested	$45,855	Match	$ 36,668
Other Federal Funds	$ 0	Total project cost	$ 82,523

2.0 Statement of Need

2.1 Water Quality Priority

In accordance with section 303(d) of the federal Clean Water Act (CWA) South Dakota has submitted and received approval of the 1998 303(d) Waterbody List (SD DENR, 1998). The waterbody list identifies waterbodies within South Dakota which need the development of Total Maximum Daily Loads (TMDLs). TMDLs must be developed for waters that do not or are not expected to meet applicable water quality standards with technology-based controls alone. The waterbody list also provides a priority ranking of waterbodies and schedule for completion of priority TMDLs. Several criteria were used for identification and ranking of TMDL waterbodies, taking into consideration the severity of the pollution and the uses to be made of the waterbody.

The waterbody being addressed in this proposal is Rapid Creek from Rapid City downstream to its confluence with the Cheyenne River. For this reach of Rapid Creek there are two entries on the waterbody list for *Impairment-related TMDL Waters* and one entry for *Surface Water Discharge-related TMDL Waters*. The key components of these listings are given below;

Impairment-related TMDL Waters:

Location	Beneficial Use	Parameter	Information	Priority
Below Rapid City	5-7-8-9-10	fecal coliform	'96 305(b) report, DENR WQM	3
Near Farmingdale	5-7-8-9-10	TSS, fecal coliform	'96 305(b) report DENR WQM	3

Surface Water Discharge-Related TMDL

Location	Permittee	Parameter	Priority	Note
Near Rapid City	Rapid City	Ammonia, DO	1	Major permit

Additionally, the surface water discharge-related TMDL is listed on the 1998-2000 Biennium targeted TMDL waters, which are the TMDLs to be completed over the next two years.

2.2 Rapid Creek Characteristics

Rapid Creek, which drains an area of about 700 mi^2, is a perennial stream that originates in the limestone plateau within the Black Hills and flows eastward through Rapid City (Figure 1). The upstream reach of Rapid Creek has an average gradient of about 48 feet per mile, and is comparatively narrow and fast running. The bed of the creek consists of sand, gravel, and cobbles derived from surrounding surface exposures of crystalline rock, sandstone, and limestone. Upstream and through Rapid City the stream is a fairly stable channel that is armored during low flows. At high flows some bank erosion occurs that is controlled by either rock outcrops or stream bank vegetation. In Rapid City, Rapid Creek turns to the southeast and flows 70 miles to its mouth at the Cheyenne River near Creston, South Dakota. Within this reach the gradient is about 13 feet per mile, and stream velocities are considerably less than the upstream reach. The creek meanders through a broad alluvial valley that is floored by easily erodible shales and has a muddy bottom (US Geological survey, 1991)

Flow characteristics of Rapid Creek are controlled through the management of two reservoirs, Deerfield and Pactola. Deerfield is located about 53 miles upstream of Rapid City on Castle Creek and has a storage capacity of 15,504 acre-feet. Pactola is located on Rapid Creek about 21 miles upstream of Rapid City and has an active storage of 54,955 acre-feet. The long-term average annual discharge in Rapid Creek near Rapid City is approximately 34 ft^3/sec. This water resource provides water for domestic, irrigation, fisheries and recreational uses. Rapid City obtains most of its water supply from three shallow, horizontal, infiltration galleries located in the Rapid Creek alluvial aquifer. These galleries have a combined production capacity of approximately 11 million gallons per day.

Irrigation withdrawals from Rapid Creek are extremely variable and represent a total withdrawal of approximately 30 ft^3/sec. Bennet Ditch, Leedy ditch, and Storybook ditch are located in western Rapid City. These ditches provide minor amounts of water (generally less than 2 cfs) for lawn and garden watering by residents located along the ditches. A number of agricultural-irrigation ditches, which are owned and operated by individual ditch companies, divert water from Rapid Creek for users east of Rapid City. These have included, in downstream order, the Iowa , Lockhart, Hawthorne, Murphy, cyclone, south Side, and Little giant ditches, with diversion points located both upstream and downstream of the Rapid City wastewater treatment plant discharge. The Lone Tree, St. Germaine, and Hammerquist ditches are located farther downstream near Caputa. Understanding the operation of these ditches will be important to characterizing flows in Rapid Creek and defining design conditions for TMDL development.

2.3 Land Use and Vegetation

Land use within the Rapid Creek basin, and the Black Hills in general, has become increasingly diversified as multiple uses of natural resources have developed. Ponderosa pine is the dominant species within the upstream part of the basin. White spruce, quaking aspen, and paper birch are also commonly found, generally in cooler, wetter areas. The forest provides for an active timber industry, with saw timber, posts and poles, and pulpwood being primary products.

The Black Hills, both private and federal lands, are used as summer pasture for cattle. Black Hills streams provide irrigation for approximately 8,900 acres within the Rapid Valley Water Conservancy District, located southeast of Rapid City. Most farms in the District are a combination of irrigated and dry-land acreage. They typically produce corn, alfalfa, small grains, and pasture, primarily as feed supplies for livestock (USGS, 1990). In general, the agricultural industry within the rapid Creek basin historically has maintained a uniform level of activity.

Housing developments within the Black Hills and east of Rapid City have expanded recently. Many of the developments on the fringe and outward from Rapid City are on private sewer systems. The recreational industry in the Black Hills, which includes tourism, hunting, fishing, boating, hiking, camping, snowmobiling, skiing, and biking, has grown significantly in recent years. The competition for water resources within the Black Hills is constantly changing and increasing with time and becomes more apparent in dry years. The various land uses discussed have the potential to alter both the quantity and quality of surface and ground waters within the Black Hills.

The Rapid Creek Watershed can be grouped into three areas or reaches, 1) above Pactola Dam, 2) from Pactola Dam to Rapid City (upstream of Canyon Lake), and 3) below Canyon Lake through Rapid City. A significant percentage of the watershed area above Pactola is managed by the Black Hills National Forest. They have an active watershed management program that is identifying impaired areas and

implementing appropriate control measures. The reach from Pactola Dam to Canyon Lake has a larger portion of area that is private. One of the primary concerns has been control of nutrient and sediment loading to Canyon Lake. A 319 project was completed on Canyon Lake, which included sediment removal and improvement of in-lake hydraulics. Additionally, a joint City/county committee evaluated options for control of septic tank systems, especially along the riverine corridor from Canyon Lake to Pactola. Below Canyon Lake master drainage plans for watershed areas that are impacted by urbanization and have significant potential to impact the water quality of Rapid Creek have only considered control of stormwater quantity. This assessment focuses on the reach from below Canyon Lake to the confluence with the Cheyenne River. This reach of Rapid Creek has a drainage area of approximately 328 mi^2.

2.4 Watershed Water Quality Problem

There is limited documentation of water quality concerns below the Rapid City wastewater treatment plant discharge (WWTPD). The US Geological Survey and SD DENR both have water quality sampling sites along Rapid Creek From Rapid City to the confluence with the Cheyenne River (Figure 2). Do to the proximity of these sampling sites they represent approximately five locations. There has been concentrated sampling above and below the WWTPD to evaluate wasteload allocations to the WWTP. Additionally, a study was conducted on metals, however there are no published results from that study. The most significant effort has simply been the analysis for the 1998 Waterbody List. As presented earlier the primary parameters of concern are fecal coliform, total suspended solids, ammonia, and dissolved oxygen. A primary concern is the WWTPD impact on water quality and attaining water quality standards for current and future conditions.

3.0 Project Description

3.1 Project Goals

The primary goal of this project is to conduct a watershed assessment along lower Rapid Creek that will characterize point and nonpoint sources of pollution, providing information for identification and evaluation of watershed management alternatives and development of the TMDL for lower Rapid Creek. To develop a realistic TMDL for lower Rapid Creek the project must take on a watershed assessment approach recognizing the information needed for TMDL development. The project objectives and tasks presented in the following section integrate the necessary components for a TMDL which include; 1) target identification, 2) identification of current deviation from target, 3) source identification, and 4) allocation of pollutant loads. Additionally, this assessment will provide recommendations for the implementation plan.

3.2 Objectives and Tasks

<u>Objective 1: Characterization of Existing Conditions</u>

Task 1-1. Target Identification

Coordination will be initiated with SD DENR, City of Rapid City, the Soil Conservation Service District, the Natural Resources Conservation Service, and the US Geological Survey to identify existing water quality data, flow measurement data and landuse activities. This information will be used to verify pollution parameters of concern identified in the TMDL list. This will be accomplished by comparing available information and data to current water quality standards along the study reach.

Task 1-2. Quantify Current Deviation from the Target

This task will focus on gathering and compiling information necessary for modeling watershed loadings and receiving water quality. Using existing available data and simple modeling techniques, load reductions necessary to achieve and maintain water quality standards will be initially quantified.

Task 1-3. Source Identification

Evaluation of information compiled and developed in tasks 1-1 and 1-2, review of existing land uses and permitted discharges will be done to identify probable sources of pollution. Identification of probable sources of pollution will enable finalization of the proposed sampling locations. Sampling locations will be selected to characterize the receiving water body, Rapid Creek, and to characterize different tributary land uses along the study reach. Although this proposal presents a monitoring plan, this task is critical to making sure the monitoring data gathered will meet the objectives of the project.

Products

The result of tasks 1-1 through 1-3 will be a detailed characterization of existing conditions and a finalization of the monitoring plan.

Budget

Item	Cost
Principle Investigator	$ 1,060
Graduate Student(s)	4,925
Travel	57
Phone	9
Reproduction	25
Supplies	50
Total	$ 6,126

Objective 2: Rapid Creek Sampling Program

Task 2-1. Rapid Creek Water Quality Sampling

The primary purpose of sampling is to provide information for quantification of existing loads, and calibration and validation of modeling efforts. This proposed sampling program will be finalized as specified in task 1-3 through coordination with SD DENR and project cooperators. Sampling site locations must consider existing USGS gauging stations and current DENR sampling sites. We propose to establish eight sampling sites along Rapid Creek. The eighth site has not been defined and will be located based on completion of task 1-3. The general location of proposed sampling sites are;

Site Description	Latitude	Longitude
Downstream of Canyon Lake at Park Drive	44°03’33’’	103°17’02’’
East Edge of Rapid City	44°03’36’’	103°10’58’’
Upstream of Rapid City WWTP	44°01’26’’	103°07’05’’
Downstream of Rapid City WWTP	44°01’20’’	103°04’40’’

Rapid Creek Near Caputa	43°59'30''	102°59'05''
Rapid Creek Near Farmingdale	43°56'32''	102°51'13''
Rapid Creek Near Creston	43°54'47''	102°42'22''

Figure 2 shows the location of the proposed monitoring sites. The proposed sampling sites are at or near active or recently active USGS stream gauging stations. It is assumed stage discharge relations will still be reasonably accurate for inactive stations. Discharge measurements will be determined by measuring stage and converting to discharge using established stage-discharge relationships. Stage measurements will be supplemented with in-stream discharge measurements using a current meter and standard USGS discharge measurement techniques. In-stream measurements will be subject to flow conditions.

All samples will be collected using methods described in the Standard Operating Procedures for Field Samplers by the State of South Dakota Clean Lakes Program. The proposed duration and frequency of sampling at Rapid Creek sampling sites is to sample bi-weekly for approximately one year at all eight sites. This will result in approximately 200 samples, which includes 10% for QA/QC. This sampling period will cover snowmelt runoff, the irrigation season and low-flow conditions. Approved QA/QC procedures as identified by the Standard Operating Procedures for Field Samplers by the State of South Dakota Clean Lakes Program will be strictly followed.

Parameter analysis will be conducted by a local (Rapid City) private lab with EPA certification. Initial proposed parameters to be determined are:

Physical	Chemical	Biological
Air Temperature	Total alkalinity	Fecal Coliform
Water Temperature	Field pH	
Discharge	Dissolved Oxygen	
Stage	Total solids	
Visual Observations	Total Dissolved Solids	
	Total Suspended Solids	
	Ammonia	
	Un-ionized Ammonia	
	Nitrate-Nitrite	
	Total Kjeldahl Nitrogen	
	Total Phosphate	
	Total Dissolved Phosphorus	

Task 2-2. Benthic Macroinvertebrate Sampling

The purpose of benthic macroinvertebrate sampling will be to provide background information on existing communities. Three samples will be collected at each sampling site. Samples will be collected using a standard surber sampler.

Products

Rapid Creek water quality report with validation of existing in-stream loads and characterization of existing benthic taxonomic groups.

Budget

Item	Cost
Principle Investigator	$ 5,011
Graduate Student(s)	11,600
Travel	1,428
Phone	22
Reproduction	25
Supplies	1,000
Analysis	22,720
Total	$41,806

Objective 3: Tributary Watershed Sampling Program

Task 3-1. Tributary Watershed Sampling

Clearly the challenge of this project is characterization of loadings from tributary watersheds to Rapid Creek. In-stream sampling of Rapid Creek will provide characterization of increased loading along the study reach. To supplement in-stream sampling of Rapid Creek a minimum of four tributary watershed areas will be selected for sampling. The tributary watersheds to be sampled will be determined based on completion of tasks 1-1 through 1-3. A primary objective will be to select watersheds that provide a representation of the different land use characteristics within the study area.

Sampling of tributary watersheds will be done to characterized snowmelt runoff and event based runoff. Sampling will be conducted at the initiation of snowmelt runoff and continue weekly until snowmelt runoff ceases. At a minimum we plan to collect composite samples from four runoff events at each tributary watershed. The total number of samples from tributary watersheds is approximately 40 samples and includes 10% for QA/QC. The same parameters identified for Rapid Creek will be determined for the watershed tributaries (see task 2-1). Approved QA/QC procedures as identified by the Standard Operating Procedures for Field Samplers by the State of South Dakota Clean Lakes Program will be strictly followed.

Flow measurement at tributary watersheds will depend on site conditions and availability of equipment. At a minimum flow will be measured during sampling events using a slope area technique. Where possible weir structures with continuous stage recorders will be install to provide a continuous record of flow measurement.

Products

Watershed water quality report documenting tributary loadings for selected parameters of concern.

Budget

Item	Cost
Principle Investigator	$ 2,733
Graduate Student(s)	6,992
Travel	571
Phone	9
Reproduction	25

Supplies (weir structures)	3,400
Analysis	3,530
Total	$17,260

Objective 4: Assessment of Pollution Load Reductions

Task 4-1. Evaluation of Tributary Watershed Loading Impacts

The objective is to evaluate the impacts due to tributary watershed areas and identify potential load reductions. Two approaches will be developed in the analysis; 1) simplified evaluation of the entire contributing watershed area based on previous studies and simplified loading equations, and 2) detailed modeling of the four tributary watershed areas sampled during the project. Model selection will be based on the primary land use within each watershed and coordinated with SD DENR and NRCS.

Task 4-2 Evaluation of Point Source Loading Impacts

To develop the TMDL for lower Rapid Creek it will be necessary to identify the point source loading impacts and identify potential load reductions. The assessment of the point source load will rely on significant coordination and input from SD DENR's Surface Water Quality program.

Task 4-3 Receiving Water Quality Modeling

The water quality of Rapid Creek will be modeled to evaluate the effectiveness of the potential load reductions of both point sources and nonpoint sources. Again, we will coordinate with SD DENR regarding model selection however we initially propose to use the EPA QUAL2E water quality model. QUAL2E is capable of simulating temperature, bacteria, BOD, DO, ammonia, nitrate, organic nitrogen, phosphate and organic phosphorus, and algae.

Products

Characterization of water quality impacts due to existing loading conditions, recommended potential load reductions and critical area locations within the watershed of lower Rapid Creek.

Budget

Item	Cost
Principle Investigator	$ 3,064
Graduate Student(s)	10,684
Travel	57
Phone	17
Reproduction	25
Supplies	50
Total	$13,897

Objective 5: Watershed Management Alternatives and Final Report

Task 5-1. Identification of Watershed Management Alternatives and Final Report

The purpose of this task is to identify cost effective watershed management alternatives that will result in the potential load reductions determined under objective 4. The identification of watershed management alternatives will be based on review of past performance of best management practices as they relate to the various land uses within the study area. The final report will present the data gathered and compiled for this assessment, a listing of recommended watershed management alternatives, and the TMDL for lower Rapid Creek

Products

The final report documenting the data, methods and results of the assessment, listing of recommended watershed management alternatives, and the TMDL for lower Rapid Creek.

Budget

Item	Cost
Principle Investigator	$ 848
Graduate Student(s)	1,970
Travel	57
Phone	9
Reproduction	500
Supplies	50
Total	$ 3,434

3.3 Project Schedule

The EPA evaluation process establishes the earliest starting date to be approximately February 1, 1999. Based on this starting date, Table 1 gives the schedule for the proposed project.

4.0 Coordination Plan

SDSM&T will serve as the project sponsor in close cooperation with the following cooperating agencies;

City of Rapid City
Natural Resource Conservation Service
Pennington Soil Conservation District
SD DENR (Watershed and Surface Water Quality Programs)
Procter & Gamble

Several discussions of the project with the City of Rapid City and Procter and Gamble have benefited in an understanding of the objectives of the project and the use of the information for TMDL development. The City of Rapid City has expressed interest in how the data and sampling will be used for the permitting of the WWTP discharge. Dan Bjurke, Kelli Buscher (SD DENR Surface Water Quality), and myself have discussed this aspect of the project.

Initial communication has been made with Gene Waterson of the NRCS. Key contacts will be Gene Waterson and Steve Quissell with the NRCS and Rob Baumberger with Pennington Conservation District. They are strongly interested in this project especially with regard to the agricultural community.

It is readily apparent that this watershed assessment and TMDL will have a high interest to several entities. An outreach plan will be developed to create an advisory or TMDL strategy group. SDSM&T will be responsible for project coordination and implementation. SDSM&T will contract individually with SD DENR, the City of Rapid City and Procter & Gamble.

5.0 Monitoring

Monitoring is an essential and significant component of the project. The proposed monitoring program is presented under objective 2. After review of existing available information a preliminary monitoring plan, as identified in Task 4, will be developed and presented to DENR and the TMDL advisory group. Upon finalization the plan will be implemented. The project sponsor will produce bi-annual progress reports.

6.0 Project Budget

The proposed project budget is summarized below and presented in Tables 2 and 3. Table 2 gives the amount and source of federal and non-federal funds to be used during each year of the project. Table 3 gives a more detailed description of the budget allocation. The City of Rapid City has expressed a willingness to contribute approximately $20,200 in cash. Procter & Gamble has shown interest in supporting this project. However, they have not currently confirmed monetary support for the project. SDSM&T will be providing $16,547 from their Water Resources Fellowship and associated tuition reduction as part of the required matching. No other federal funding sources have been identified at this time.

	OBJECTIVE					
Description	1	2	3	4	5	TOTAL
P.I.	$1,060	$ 5,011	$ 2,733	$ 3,064	$ 848	$ 12,716
Grd Student(s)	$4,925	$ 11,600	$ 6,992	$ 10,684	$ 1,970	$ 36,171
Travel	$ 57	$ 1,428	$ 571	$ 57	$ 57	$ 2,170
Phone	$ 9	$ 22	$ 9	$ 17	$ 9	$ 66
Reproduction	$ 25	$ 25	$ 25	$ 25	$ 500	$ 600
Supplies	$ 50	$ 1,000	$ 3,400	$ 50	$ 50	$ 4,550
Analysis	$ 0	$ 22,720	$ 3,530	$ 0	$ 0	$ 26,250
Totals	$ 6,126	$ 41,806	$ 17,260	$ 13,897	$ 3,434	$ 82,523

References

US Environmental Protection Agency, 1998, Draft TMDL FACA Committee Report, Total maximum Daily Load Program, US EPA Office of Water, (http://www.epa.gov/OWOW/tmdl/faca/toc.html).

US Environmental Protection Agency, 1991, Guidance for Water Quality-based Decisions: the TMDL Process, US EPA Office of Water, EPA 440/4-91-00, Washington, D.C.

US Geological Survey, 1990, *Basin Characteristics, History of Stream Gauging, and Statistical Summary of Selected Streamflow Records for the Rapid Creek Basin, Western South Dakota.* US Geological Survey Open-file Report 90-120, Rapid City, South Dakota.

US Geological Survey, 1991, *Selected Water-Quality Data for Rapid Creek Basin, Southwestern South Dakota, 1946-90*. US Geological Survey Open-file Report 91-249, Huron, South Dakota.

SD Department of Environment and Natural Resources, (1998). *The 1998 South Dakota 303(d) Waterbody List and Supporting Documentation.* Pierre, South Dakota.

SD Department of Environment and Natural Resources, Office of Water Resources Management (1991). *South Dakota, Section 319, Nonpoint Source Management Program Plan Update.* Pierre, South Dakota.

Table 2. Budget Table for Lower Rapid Creek Watershed Assessment and TMDL Development

Funding Sources	1999	2000	Totals
EPA Section 319 Funds	$ 26,700	$ 19,155	$ 45,855
State/Local Match			
Procter & Gamble	$ 0	$ 0	$ 0
SDSM&T	$ 7,446	$ 9,101	$ 16,547
Rapid City	$ 10,000	$ 10,121	$ 20,121
Subtotal	$ 17,446	$ 19,222	$ 36,668
Total Budget	$ 44,146	$ 38,377	$ 82,523

Table 3. Budget Allocation for Lower Rapid Creek Watershed Assessment and TMDL Development

Budget Item	1999	2000	Totals	Cost Share Match			319 Funds
				SDSM&T	Procter & Gamble	CRC	
Salaries, Wages, Fringe, & Indirect	$ 22,000	$ 26,887	$ 48,887	$ 16,547	$ 0	$ 20,121	$ 12,219
Materials & Supplies	$ 4,050	$ 1,100	$ 5,150				$ 5,150
Travel	$ 1,085	$ 1,085	$ 2,170				$ 2,170
Telephone	$ 40	$ 26	$ 66				$ 66
Laboratory Analysis/Sampling	$15,750	$ 10,500	$ 26,250		$ 0		$ 26,250
Totals	$42,925	$39,598	$ 82,523	$ 16,547	$ 0	$20,121	$ 45,855